

# Snowmass 2001 Accelerator R&D Report

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HEPAP meeting  
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## Snowmass 2001

Total of 27 working groups:

- 6 M-groups

- 9 T-groups

- 7 E-groups

- 5 P-groups

Each WG carried out a 3-week study.

Total integral of effort is substantial, reflects the scale of the commitment of the community.

Organization: DPF Quigg  
DPB Davidson

This talk concentrates on the Accelerator R&D Report.

There were 15 accelerator working groups  
(6 “machine” + 9 “technology”)

<u>Working Group</u>	<u>Conveners</u>
M1 Muon-Based Systems	McDonald, Sessler
M2 e+e- Circular Colliders	Oide, Seeman, Hendersen
M3 Linear Colliders	Brinkman, Toge, Raubenheimer
M4 Hadron Colliders	Peggs, Syphers
M5 Lepton-Hadron Colliders	Ben-Zvi, Hoffstaetter
M6 High Intensity Proton Sources	Chou, Wei
T1 Interaction Region	Markiewicz, Pilat
T2 Magnet Technology	Gourlay, Kashikhin
T3 RF Technology	Adolphsen, Holtkamp, Padamsee
T4 Particle Sources	Sheppard, Mokhov, Werkema
T5 Beam Dynamics	Blaskiewicz, Lee, Kim
T6 Environmental Control	Bialowons, Laughton, Seryi
T7 High Performance Computing	Ko, Ryne
T8 Adv. Acceleration Techniques	Joshi, Sprangle
T9 Diagnostics	Pasquinelli, Ross

Each working group  
has a specific charge  
writes 20-30 page summary report  
writes 1-2 page executive summary

## **2001 Snowmass Accelerator R&D Report**

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### **Abstract**

The purpose of this report is to provide a perspective on future accelerator projects, and to identify the R&D activities necessary to prepare for these projects. The report summarizes the conclusions of accelerator studies made during the 2001 Snowmass Summer Study on the Future of Particle Physics. In doing so, it serves as a summary of the opinions on accelerator R&D expressed by the scientific community as it looks towards the next few decades. The main technical content is provided by the Executive Summaries of each of the fifteen accelerator Working Groups. These Working Group Executive Summaries form an integral part of this report.

## Contents:

### Part 1:

- Introduction

- Brief history of Accelerator Developments for Particle Physics

- Importance of Accelerator Physics and Technology to Science Research

- Current Status of Particle Physics Research

- Goals of Snowmass Summer Study

- Process of the Report

- Opportunities in Accelerator R&D

- International Collaboration

- Highlights from the working group summaries

### Part 2:

- Technical contents

(collection of Executive Summaries from the 15 accelerator WGs.)

<http://www.hep.anl.gov/pvs/dpb/Snowmass.pdf>

This talk concentrates on Part 1.

# Importance of Accelerator R&D to Particle Physics

In the past, accelerator R&D has led to advances in accelerators required for particle physics.

Today, advances in accelerators will require more than ever before a sustained R&D effort.

In the immediate future, we have many activities on various upgrades at all laboratories.

In the near future,  
Linear collider  
Neutrino/muon facilities  
Very large hadron collider  
Lepton-hadron colliders  
Lepton circular colliders  
Intense proton drivers

In the far future, there are a multitude of ideas worth pursuing and must be pursued.

All of the above activities require R&D in accelerator physics and technology. Elaborations at Snowmass by the 15 WGs made it clear that the total work load is very high.

## **Immediate future**

With the recently built accelerators, the field of HEP has enormous potential for discoveries in the immediate future. This resulted from the foresight of the HEP community to invest in accelerator R&D in the past.

Every lab has been trying to maximize the HEP output utilizing existing facilities in many most creative ways. The research is exciting. The benefit to HEP is very obvious.

## **Near and Far Future: Goals of Snowmass**

The immediate future is on track and exciting. However, utilizing existing facilities can only go so far.

One goal at Snowmass is to elucidate a vision, and to delineate the steps to be taken now to fulfill this vision.

These steps are, to a large degree, accelerator R&D. An increasing heavy workload the HEP community must prepare to face.

Given the long lead time required for the next generation of accelerators, it is imperative that the planning and R&D for these accelerators be undertaken vigorously now.

## **Process of the Report**

Each Working Group received a charge. Information requested generally included

- evaluation of the present status
- comparison of available technical approaches
- enumeration of the necessary R&D in a time-ordered fashion
- where appropriate, estimates of the budgetary and manpower resources required for the R&D.

Each working group has reached consensus within the group and reported the consensus in their summaries.

## **Common Themes**

A few common themes were expressed throughout Snowmass:

- Independent of the type of the next major facility or where is to be built, it will have to be a truly international undertaking, while keeping regional programs strong.
- Regardless of the choice of the next major facility, R&D on the remaining proto-projects must be continued.
- Beam physics research and advanced accelerator R&D must be continued to assure the near and far future of particle physics.
- Majority view that the next major facility ought to be a linear collider. Accelerator WGs made major steps towards removing contentiousness among different LC designs.

## **Opportunities in Accelerator R&D**

It is clear that a great deal of pioneering and challenging accelerator R&D is needed to

1. support immediate, and near future (linear colliders etc) HEP programs
2. develop the concept and tools for the far future of HEP.

These exciting opportunities occur in parallel with an urgent need. Active participation by the HEP community is needed across the board:

accelerator physics, engineering, computation, and beam diagnostics.

An indication: there are ~3300 particle physicists in the US, but only ~300 high energy accelerator physicists. Too few people are taking on too heavy a load.

We need to increase the support of accelerator R&D. First and foremost, we need more smart, intelligent, energetic people.

## International Collaboration

One of the main consensuses reached at Snowmass is the importance of international collaboration. This must be done, and is not a matter of choice.

Accelerators so far have traditionally been undertaken by one nation/region. This model will not be sustainable for future major projects.

In such an international collaboration, all nation/regions contribute in major ways. A mechanism is lacking, and needs to be designed. It is a necessary part of vision into the future.

A Global Accelerator Network model is under active investigation.

- There appears to be no fundamental technical obstacle.
- Proto-type experiments are planned to demonstrate its feasibility.
- This is an important activity. International collaboration must be built-in in our vision for the future programs.

Nature of Snowmass might change in the future from a US meeting to an international meeting. Next Snowmass in Europe? 2003?

## **Executive Summary Reports by the Working Groups**

These are the main technical part of the Snowmass Accelerator R&D Report. They were results of 3 weeks of hard work, with an aim of reaching consensus within the group. These are very important documents by the community and are to be taken extremely seriously.

## Summary

- Beam physics and accelerator R&D is essential for the immediate, near-future, and far-future of experimental particle physics, as well as many other sciences.
- Support of accelerator R&D should be substantially increased.
- International collaboration must be built-in in the agenda of an overall plan of particle physics. This collaboration should start with the R&D phase.
- Participation of particle physicists in accelerator R&D is urgently needed.
- Technical reports from the working groups (not reported in this talk) are very important documents.